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Based on energy-saving of utilization and development of urban underground space resource of Qingdao

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Abstract

The upper space is saturation, and the high-rise building will consume much material, like concrete, steel and timber. However the underground space is more energy-saving. Underground space is a kind of important resource during urban continued advance. It is foundation of developing and utilizing underground space that we should deeply recognize environment characteristics of urban engineering geology and strengthen the study on urban underground engineering geological problem. In the same time, It is the key of scientifical and reasonable utilization of new technology in underground geotechnical engineering to development of urban underground space. At last, the evaluate method of the underground cavity capacity is put in to use of Qingdao underground space resource estimation.

Keywords: energy-saving; urban; underground space; Qingdao

1. Introduction

As the host city for the 2008 Olympic Games, the development of Qingdao can not separable from the development of underground space. Like the other cities, the underground space development and utilization of Qingdao began in civil engineering construction of the late 1960s. In recent decades, Qingdao has given priority to the civil engineering construction of underground space development and utilization, and made great achievements in the scale. Per urban capita reached 0.5m2. But the underground space resource in Qingdao is far more than that. The reason lies in Qingdao is located in the new Chinese uplift second order tectonic units, Jiaonan uplift the northeastern edge and Jiaolei sag. The

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whole city is located in south area YiShan and flax form granite piece granodiorites and laoshan type granite. The engineering geological conditions provided advantaged condition for urban underground space development and utilization of project[1].

2. Summarize on engineering geology of Qingdao

Qingdao is located in shandong peninsula south coast, the climate amenity and is a unique coastal city. The whole area is 10654 km^2. The coastline (contain subordinate island coast) is 870 km, including mainland coastline 730km. The inland area of exploitation is 266 km^2 [2].

Qingdao stratum can be divided into formation from old Cenozoic quaternary and Mesozoic cretaceous and the Jiaonan cluster. Qingdao area mainly is granite rock, others are \metamorphic sedimentary rocks and volcanic rock.

3. Estimate on underground space resource of Qingdao

How to make full use of underground space resource, he maximum benefit mankind to the extent permitted in the environment, is widespread concern. The size, depth and distance, cross cavern excavation will greatly influence the capacity of the underground space. Therefore, in order to make the assessment from qualitative to quantitative, numerical simulation study on the factors influence of underground space capacity. Serve as Qingdao, FLAC3D use for evaluation of above factors were analyzed.

Qingdao area mainly is granite, most of the underground excavation activities are conducted in the granite. Therefore, physical and mechanical parameters of granite as the initial value flac3d input.

3.1. Influence of size

The underground space size is the direct factors size of cavern. How much space in the underground excavation of underground excavation is all activities should be considered. Rational cavity size can not only reduce project cost, but also can deal well with the relationship between environmental underground excavation.

In certain depth a cavern is excavated, and the length is 6,12,24,48 respectively. Get the maximum principal stress distribution map and get the following conclusions:

(1) after excavation, roof and floor ends corner has obvious stress concentration in place, and reach a maximum sensitisity.

(2) The stress redistribution after excavation, caused by the initial geostress is ratio to objectively reaction stress redistribution. As the cavity dimension, the ratio of shrinking to increase gradually, and the principle of the description about the holes,

(3) As cavities expand the size, stress redistribution sphere of influence and the plastic area expands gradually, and the stress concentration degree was reduced gradually, and the elastic stress concentration in the hole.

According to the above conclusions, the underground cavern inevitably leads to the excavation of stress concentration, but with the increase of cavities in size, and the stress concentration degree is not a linear relationship in length, the highest for 40 arrived. Therefore, in the surface subsidence effectively controlled, can allow the Angle of geological environment around, should handle excavation cavity dimension and the stress concentration of the relationship, enlarge the underground space, avoid excavation size high stress concentration.

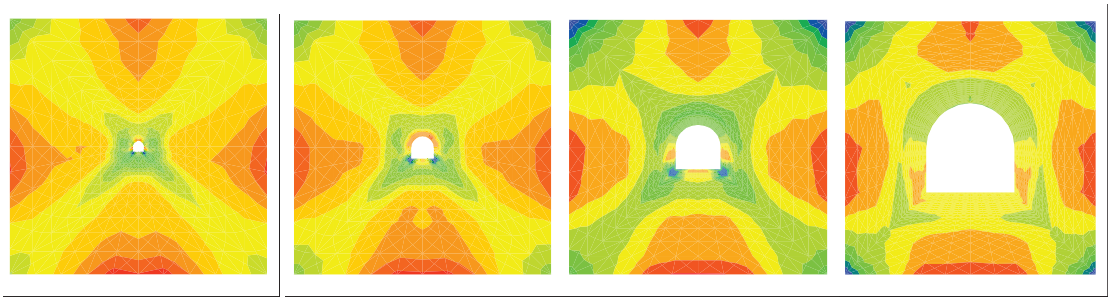

Fig. 1. Principal stress of different size caverns

3.2. *Influence of depth*

Urban underground space resource evaluation scope for underground 10 m above average, and the depth of the underground space development and utilization of underground 10m range has far surpassed its development trend, is 50-100m deep underground space. Now 10~30 shallow underground space in many developed countries has developed the basic[3, 4], comprehensive utilization of underground space resource for underground space development, gradually to The Times and deep development of deep. Therefore in the evaluation of Qingdao spatial capacity, excavation scope is in 10m~100m. At the same time, the cavern under a new cavity, excavation of underground space and expand capacity of effective measures.

(1) With the increase of depth cavern, when the buried depth to 70m, basically is no influence on ground;

(2) After excavating, showing a strong stress variation. Near the surface principal stress changes is not only;

(3) The maximum principal stress appears in the cavern roof and floor, and the stress concentration;

(4) Compared with single excavating, the cavern roof and floor, reduced the maximum principal stress and the maximal principal stress side-wall rises.

Through the above analysis, we can see that the excavation and stratified cavities in underground cavern excavation under new underground cavern, is to expand the capacity of the underground.

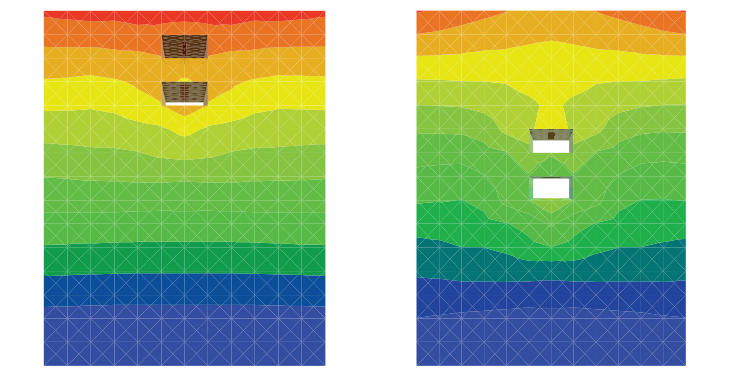

Fig. 2. Principal stress of different depth

3.3. Influence of distance

According to the actual conditions of Qingdao, The space is 2.5 times of cavity width. The exploitation of Qingdao inland is 266km^2, and divided into 10,000 small region of 210m×120m. Within this range non-equidistant layout three underground cavern, with rectangular roadways as representative, because the stress concentration of roadway cross-section shape than other serious and buried 30m.

Figure 3 shows, by cavity spacing for 2.5 times of cavity width can achieve mutual influence. Therefore, in order to maximize the use of underground space, under the condition of spacing requirements, should try to reduce the distance between the cavern, improve the utilization efficiency of underground space, the underground space for later use.

According to the concerned expert advice, estimates that a reasonable development of urban underground space resource is a total area of city by reasonable development depth of 40% income [7]. According to the volume of excavation depth for 10m Qingdao underground space resource for 1.064×109m3, and according to the calculation of adjacent cavity between each other is not influence the calculated value should be less than 7.2×108m3, theory of bronze. Therefore, in the evaluation of urban underground space capacity, it is the actual geological condition is not negligible.

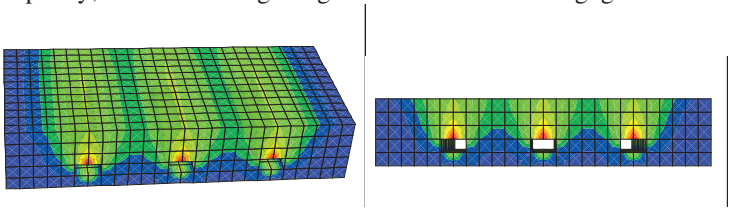

Fig. 3. Displacement contour

3.4. Influence of cross

There is a subway construction stage of Qingdao Besides the subway, tunnel, such as underground pedestrian, inevitably overlapping underground cavern, but the problem is still not right across the calculation method, only by numerical simulation.

Contrast a single excavating and cross excavating, we can get the following conclusions:

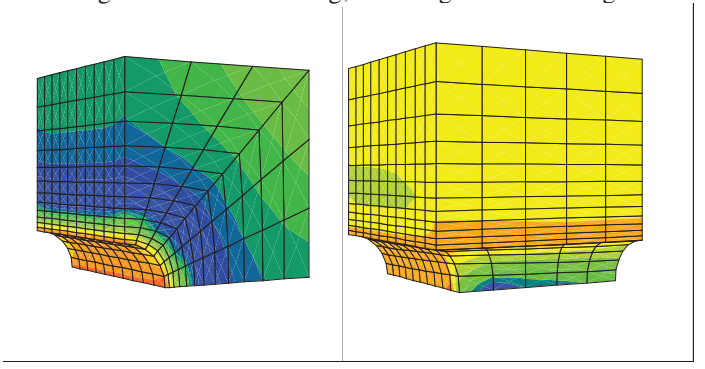

Fig. 4. Principal stress

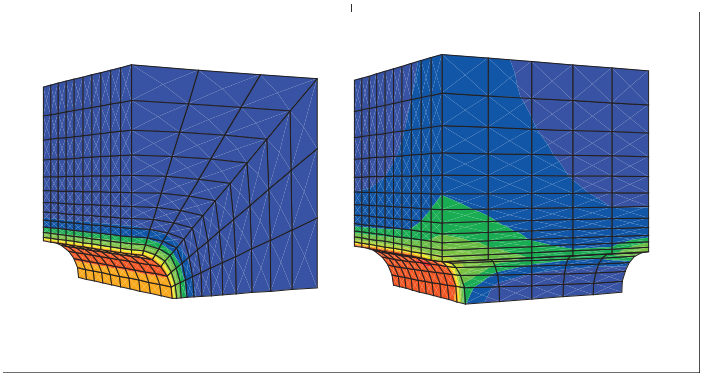

Fig. 5. Displacement contour

(1) Intersecting cavern will produce more severe stress concentration of the stability of surrounding rock, in dealing with extremely detrimental to cross cavern, junction must strengthen support,

(2) After excavating, will produce a hole to the displacement, the maximal displacement in crossing, cross in the building of a dense, prevent formation subsidence area,

(3) Bottom cavity may appear larger stress concentration.

Consider the above four factors analysis of underground space in Qingdao. The underground space is divided into two layers of excavation, consider cross factors, estimate the underground space available for Qingdao is $2.48\times10^{9}m^{3}$. And the inland area of Qingdao is $266km^{2}$. If the height is 30m, the space available for 6.384×10^{7} m^{3}, only is 1/8 of the capacity of underground space. Visible, expanding urban underground space in urban land capacity, tension, alleviate traffic etc, has more than the upper space development prospects.

4. Conclusions

The paper analyze the spatial capacity of Qingdao city by the influence factors of the underground space capacity. Through the comparison, the underground space is more promising. However, the influence factors of underground space capacity is more than these. It is affected by cavity shape, engineering geology, hydrogeology, underground pipe. The comprehensive influence of factors such as architecture, the evaluation process would also be a complicated and promising research topic.

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